2.30 Fish Passage

2.30.1 *General*

The Design-Builder shall perform all Work necessary to design, document, obtain permits, and construct fish passage and restoration of natural drainage courses for the Project. At a minimum, elements of Work shall include the following:

- Design and construct new fish passable stream channels and incorporate stream restoration elements in accordance with the Contract to eliminate the fish barriers at the following locations:

No.	WDFW Fish Passage Site ID Number	Name	SR	MP
1	**990710**	Unnamed Tributary to Hood Canal	104	16.55
2	**991612**	Unnamed Tributary to Hood Canal	3	59.52
3	**996811**	Unnamed Tributary to Hood Canal	3	59.55
4	**990395**	Spring Creek to Hood Canal	3	58.49
5	**991240**	Unnamed Tributary to Hood Canal	3	58.21
6	**991242**	Unnamed Tributary to Kinman Creek	3	57.23
7	**996729**	Unnamed Tributary to Grovers Creek	104	22.23
8	**992207**	Carpenter Creek to Appletree Cove	104	22.95
9	**991744**	Johnson Creek to Liberty Bay	3	52.21
10	**991999**	NE Dogfish Creek	307	1.34
11	**991572**	Unnamed Tributary to Dogfish Creek	307	1.45
12	**991241**	SF Johnson Creek to Johnson Creek	3	50.85
13	**996804**	Big Scandia Creek to Liberty Bay	3	49.48
14	**990235**	Scandia	308	0.9
15	**15.02801.00**	Scandia	308	1.15
16	**992008**	Little Scandia Creek to Liberty Bay	308	1.33
17	**991000**	Unnamed Tributary to Puget Sound	308	2.16
18	**15.02460.96**	Strawberry Creek to Dyes Inlet	3	44.8
19	**994085**	Hoot Creek to Barker Creek	303	6.63
20	**990024**	Hoot Creek to Barker Creek	303	6.66
21	**930416**	Unnamed to Hoot Creek	303	6.7
22	**994086**	Hoot Creek to Barker Creek	303	6.68
23	**930408**	Unnamed Tributary to Hoot Creek	303	6.7
24	**932143**	unnamed to Hoot Cr	303	6.9
25	**932154**	unnamed to Hoot Cr	303	6.64
26	**932155**	unnamed to Hoot Cr	303	6.62
27	**935880**	unnamed to Hoot Cr	303	6.35
28	**996748**	Unnamed Tributary to Dyes Inlet	3	42.56
29	**996742**	Unnamed Tributary to Dyes Inlet	3	41.52

- Prepare Specialty Report(s) in accordance with the WSDOT *Hydraulics Manual* and this Section.
- Host multiple task force and other meetings, as required, to coordinate environmental documentation, permit acquisition and the design with the WSDOT Engineer, WSDOT Headquarters Biology, WSDOT Headquarters and Region hydraulics, maintenance, and environmental staff; the Washington Department of Fish and Wildlife (WDFW), the Washington State Department of Ecology, and Tribal representatives.
- As part of the Phase 1 Services, ensure all application materials are complete and in compliance with guidance from WDFW and the USACE prior to submittal. Obtain concurrence from the Tribe(s), WDFW, and WSDOT on the entire permit application package (including the JARPA) before submitting the completed package to the U.S. Army Corps of Engineers.

Issuance of both the HPA and the Section 404 permits is dependent on concurrence by the Tribe(s) and WDFW that the design of the fish passage meets the requirements of the Permanent Injunction Regarding Culvert Correction, United States District Court, Western District of Washington at Seattle, No. C70-9213 Subproceeding No. 01-1 (Culverts), ordered March 29, 2013, and applicable standards. The US Army Corps of Engineers will generally not issue the Section 404 permit without concurrence from the Tribes that they are satisfied with the design. It is a material requirement of the PDB Contract for the Design-Builder to obtain Tribal and WDFW concurrence for its design and permit applications, and to all the following:

1. Design-Builder shall employ a Stream Team that has the experience, knowledge, skills, and ability to provide a design, for each fish passage crossing, that will comply with all PDB Contract requirements, and that these PDB Contract requirements include obtaining concurrence from the Tribe(s) and WDFW on its design and permit applications.
2. Design-Builder has included in each Base Culvert Bundle GMP adequate amounts on account of price and schedule risk related to obtaining concurrence from, and satisfaction of the standards of the Tribe(s) and WDFW for its design, and hereby acknowledges that Design-Builder is at sole risk and responsibility for doing so.

2.30.2 *Definitions*

The following definitions apply to the terms used in this Section. The "Structure Free Zone Definitions Exhibit" (Appendix 4) is hereby incorporated into and made part of the following definitions and shall be used in interpreting the meaning of these defined terms.

Average 100-Year Stream Slope Under Structure (A100SS) – The slope is calculated by dividing the difference in the 100-year water surface elevations, between the ends of the measurement of Hydraulic Length, by the Hydraulic Length.

Bearing of Stream – The imaginary line that meets all the following: (1) equidistant between the Structure walls (or abutments) to the left and right of the stream, (2) at the A100SS slope, and (3) at the 100-year streamflow MRI water surface elevation. This line is irrespective of the location of the thalweg or any sinuosity in the stream bed.

Controlling Bottom Elevation (CBE) – An imaginary surface that represents the bottom boundary of the Structure Free Zone (SFZ). At any vertical cross section of the SFZ, taken at a horizontal angle of 90 degrees to the Bearing of Stream, the CBE shall be a horizontal line located:

- When any part of the structure or its foundation is located under the vertical shadow of the Hydraulic Width, the CBE shall be at least two feet below the elevation of scour for the Scour Check Flood. Examples of this would be the bottom slab of a four-sided buried structure, a circular pipe, or the footings of a bridge or three-sided buried structure if the footings extended horizontally toward the center of the structure far enough to fall under the vertical shadow of the Hydraulic Width.
- When no part of the structure or its foundation is located under the vertical shadow of the Hydraulic Width, the CBE shall be at the elevation of scour for the Scour Check Flood, or lower.

Controlling Top Elevation (CTE) – An imaginary surface that represents the top boundary of the SFZ. At any given vertical cross-section of the SFZ, taken perpendicular to the horizontal alignment of the Bearing of Stream, the CTE shall be the higher of the following elevations:

1. The elevation is calculated by adding the SFZ Height specified in Table 2.30-B to the highest streambed ground elevation within the horizontal limits of the Hydraulic Width.
2. The elevation is calculated by adding the Hydraulic Design Flood Freeboard to the elevation of the Hydraulic Design Flood.

Design Methodology – The meaning used in the *Washington Department of Fish and Wildlife Water Crossing Design Guidelines.*

Hydraulic Design Flood – The discharge and associated probability of exceedance that reflects the desired level of service for a roadway/bridge crossing a watercourse and/or floodplain. This flood drives the capacity design (i.e., size and configuration) of the waterway opening. By definition, the approach roadway or bridge should not be inundated by the water levels produced by this flood.

Hydraulic Design Flood Freeboard – The minimum dimension so designated in Table 2.30-B. It shall be measured as shown on the Structure Free Zone Definitions Exhibit.

Hydraulic Length – The longest measurable horizontal length along the stream of all components of a structure (bridges and buried structures) above the elevation of Total Scour for the Scour Check Flood. The Hydraulic Length is measured as shown in the Structure Free Zone Definitions Exhibit. For bridges and buried structures, the Hydraulic Length shall not include wing walls (but shall include their footings if above the scour for Scour that are at a horizontal skew angle of 60 degrees or greater from the Bearing of Stream but shall include wing walls that are at a horizontal skew of fewer than 60 degrees. For buried structures, components of the structure included in the measurement of the Hydraulic Length include but are not limited to the following items that are at a horizontal skew of fewer than 60 degrees from the Bearing of Stream: tapered, sloped, or beveled ends on any structural cross section including elliptical, circular, arched, rectangular, and segmented; wing walls of any shape. See Table 2.30-B for the maximum allowable Hydraulic Length.

Hydraulic Width – The minimum width perpendicular to the creek beneath the proposed structure that is necessary to convey design flow and allow for stream processes. The minimum acceptable Hydraulic Width shall be as indicated in Table 2.30-B. The Design-Builder shall not use the Hydraulic Width to determine the width of the SFZ.

Maintenance Clearance – The dimension labelled as such in the SFZ drawings. The minimum Maintenance Clearance shall be as shown in Table 2.30-B.

Projects of Similar Scope and Complexity (Relates to fish passage Work) – Projects that have the following characteristics:

- Construction of the fish passage(s) was completed within the last five years.
- The fish passage(s) was of similar size and budget.
- The fish passage included stream restoration components.
- The fish passage design followed WDFW Stream Simulation or Bridge Design Methodologies.
- The fish passage structure(s) passed under a facility (such as a roadway) that had a width over the stream and height above the stream equal to or greater than those required on this PDB Contract.
- Design and construction of the stream and bridges and/or buried structures were required to comply with the Injunction.
- Construction was delivered utilizing bid-build, design-build, GC/CM, or an emergency contract.

Regrade, Channel Regrade, Natural Channel Regrade, Natural Regrade – Each of these terms shall be understood to mean the natural process of a stream to establish an equilibrium slope by means of aggradation or degradation over time. Regrading is expected to effect changes to the stream, its bed, and banks, and may include but is not limited to incision, deposition, debris loading, downstream flooding, lateral shifting, and bank erosion. The Regrade process will be set in motion by the removal of the existing barrier to fish passage and is intended to allow the stream to return to its natural channel, by processes that are unencumbered by the design and construction of a new fish passable stream crossing. Furthermore, the Regrade process may extend to areas outside of the State right-of-way, although the degree, extent, and timing are unpredictable. To determine whether a structure is required to be designed to Regrade, refer to Table 2.30-B.

Scour Check Flood – The discharge (flood) resulting from storm, storm surge, tide, or some combination thereof having a flow rate in excess of the scour design flood, but in no case a discharge (flood) with a recurrence interval exceeding the greater of the typically used 500-year or the 2080 100- year projected discharge (flood) (if it has been deemed practicable to do so), that creates the deepest scour at structure foundations.

Scour Design Flood – The discharge (flood) resulting from storm, storm surge, tide, or some combination thereof having a flow rate equal to or less than the 100- year discharge (flood) or the 2080 100-year projected discharge (flood) (if it has been deemed practicable to do so), that creates the deepest scour at structure foundations.

SFZ Height – At any given cross-section of the SFZ, SFZ Height is the vertical dimension which, when added to the highest ground elevation within the horizontal limits of the SFZ,

determines the CTE at that cross-section. See Table 2.30-B for the minimum allowable SFZ Height.

SFZ Width – A horizontal distance measured perpendicular to the Bearing of Stream, between the nearest surface of the structure to the left of the stream and the nearest surface of the Structure to the right of the stream, at all points between the CBE and the CTE. See Table 2.30-B for the minimum allowable SFZ Width. The SFZ Width shown in Table 2.30-B includes all structure widths required for any purpose, including hydraulics, wildlife connectivity, and stream restoration.

Stream Team – The meaning given in TR Section 2.30.4.2, *Stream Team*.

Structure Free Zone (SFZ) – An imaginary, rectangular prism of infinite length both upstream and downstream, that is horizontally centered on the Bearing of Stream, is parallel to the Bearing of Stream, and represents the minimum boundary within which no part of the fish passage structure, including footings, shall be allowed unless meeting the criteria for an allowable exception in this paragraph. It is bounded on top and bottom by the CTE and the CBE respectively, with minimum interior width equal to the minimum SFZ Width specified in Table 2.30-B.Width. Allowable exceptions are as follows: Fillets may be inside the SFZ provided both of the following are true: (1) the sum of all fillet areas in each cross-section is less than the 2% of the area calculated as the SFZ Width multiplied by the SFZ Height, and (2) all fillet areas are entirely above the elevation of the Hydraulic Design Flood plus Hydraulic Design Flood Freeboard.

Total Scour – the meaning as defined by FHWA *Hydraulic Engineering Circular Number 18* (HEC-18).

2.30.3 *Mandatory Standards*

The following is a list of Mandatory Standards that shall be followed for all design and construction related to this Section as referenced in Section TR 2.2, *Mandatory Standards*.

If the requirements of a Mandatory Standard, programmatic agreement, or permit issued for the Project conflict, then the provisions within the Project-specific permit shall take precedence.

1. Glossary in the December 27, 2021, Supplement to the Hydraulics Manual"
2. WSDOT *Hydraulics Manual* M 23-03 (Appendix 4)
3. *Washington Department of Fish and Wildlife Water Crossing Design Guidelines* (Appendix 4)
4. *FHWA Evaluating Scour at Bridges* (HEC-18)
5. *FHWA Stream Stability at Highway Structures* (HEC-20)
6. *FHWA Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance Volume 1 and 2* (HEC-23)
7. *U.S. Army Corps of Engineers, Hydraulic Design of Flood Control Channels* (EM 1110-2-1601)
8. WSDOT *Temporary Erosion and Sediment Control Manual* M 3109 (Appendix 4)

9. WSDOT *Geotechnical Design Manual* (GDM) M 46-03 (Appendix 4)
10. WSDOT *Design Manual* M 22-01 (Appendix 4)
11. WSDOT *Bridge & Structures Office Design Memoranda* (Appendix 4)
12. WSDOT *Bridge Design Manual LRFD* M 23-50 (Appendix 4)
13. WSDOT *Maintenance Manual* M 51-01 (Appendix 4)
14. WSDOT *Plans Preparation Manual* M 22-31 (Appendix 4)
15. WSDOT *Construction Manual* M 41-01 (Appendix 4)
16. WSDOT *Materials Manual* M 46-01 (Appendix 4)
17. WSDOT *Environmental Manual* M 31-11 (Appendix 4)
18. WSDOT General Special Provision (GSP) regarding temporary stream diversion, either 7-06.SA1.FR7 or 7-06.SA2.FR7, whichever is appropriate for each culvert site (Appendix 4).
19. WSDOT *Guidance on Wildlife Habitat Structures in Wetland Mitigation Sites* (Appendix 4)
20. United States of America, et al., v. State of Washington, et al. Permanent Injunction Regarding Culvert Correction, United States District Court, Western District of Washington at Seattle, No. C70-9213 Subproceeding No. 01-1 (Culverts), ordered March 29, 2013 (Appendix 4)
21. Standard Specifications (Appendix 4)
22. *Washington State Aquatic Habitat Guidelines Program, Integrated Streambank Protection Guidelines* (Appendix 4)
23. *Washington State Aquatic Habitat Guidelines Program, Stream Habitat Restoration Guidelines* (Draft April 2012) (Appendix 4)
24. *Washington Department of Fish and Wildlife Fish Passage Inventory, Assessment, and Prioritization Manual, 2019* (Appendix 4)
25. *U.S. Department of Agriculture Forest Service, Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings*

2.30.4 *Personnel Requirements*

2.30.4.1 Stream Design Engineer

Stream Design Engineer Job Duties

The Stream Design Engineer (SDE) shall lead the day-to-day effort for designing the stream and its habitat and, when the PDB Contract requires, providing design support for National Environmental Policy Act/State Environmental Policy Act and permitting. This design Work shall include specialty design Work including compliance with the Injunction, hydraulic design, hydrology, stream grading, stream restoration with large woody material (LWM) placement with and without anchor system design, stream restoration with natural habitat diversity features, stream or river embankment stabilization, flood risk analysis,

geomorphology, zero rise analysis, scour analysis, streambed material design, and backwater analysis. The channel design and other elements as described above shall be designed by, or under the direct supervision of the SDE. The SDE shall be the Engineer of Record (EOR) for these specialty designs. The SDE shall be responsible for all hydraulic and hydrology Work revisions for the duration of the PDB Contract.

SDE Required Minimum Qualifications:

- Shall have a minimum of 10 years of experience in the Work listed above.
- Shall have completed the design, within the last 5 years of a minimum of three successful fish passage Projects of Similar Scope and Complexity. To be considered successful, the fish passage structures shall have been in service and remained fish passable, without modification, for at least two years.
- Shall be a Licensed Professional Engineer in the State of Washington.

SDE Desirable Qualifications

- Experience includes direct field construction support that facilitated successful implementation and modification on a Project of Similar Scope and Complexity.

2.30.4.2 Stream Team

The Stream Team shall be selected jointly by the Design-Builder and WSDOT and shall include the SDE, a Geomorphologist, and a Biologist.

Before starting any Work on this PDB Contract every member of the Stream Team shall complete all 13 modules of the WSDOT Fish Passage and Stream Restoration Training and obtain certification. The modules and test are available at https://wsdot.wa.gov/Design/Hydraulics/Training.htm

The Geomorphologist shall be a Licensed Fluvial Geomorphologist (Geology) in the State of Washington and have design and construction experience with stream restoration including stream grading, step-pool design and construction, large woody material (LWM) placement, and stream or river embankment stabilization.

The Biologist shall be an Aquatic Restoration or Fisheries Biologist that has three years of design and construction experience (at least one year of which must be designed and at least one year must be construction) with stream restoration including stream grading, step-pool design, and construction, large woody material (LWM) placement and stream or river embankment stabilization.

The Design-Builder shall submit to the WSDOT Engineer for Review and Comment on all relevant documents to establish the required experience of the SDE, Geomorphologist, and the Biologist assigned to the Stream Team.

Table 2.30-A defines the design components of the stream channel that the individual members of the Stream Team, at a minimum, are responsible for:

Table 2.30-A Stream Team Responsibilities

Design Components	SDE	Geomorphologist	Biologist
Site Assessment	X	X	X
Watershed Assessment	X	X	X
Fish Resources and Habitat Assessment	X		X
Hydrology	X		
Hydraulic Analysis	X		
Fish Passage Design	X		X
Streambed Design	X	X	X
Habitat Features	X	X	X
Scour Analysis	X	X	

2.30.5 *Design Requirements*

2.30.5.1 Preliminary Hydraulic Design Reports

The Preliminary Hydraulic Design Report(s) ("PHDs and draft Final Hydraulic Design Report(s) (FHDs)") for the fish passages included in each Culvert Bundle Amendment shall be as developed during the Phase 1 Services

The final and as-built Hydraulic Design Reports for fish barrier removal shall be developed and completed by the Design-Builder following the *Hydraulic Design Report Template* (Appendix 4). The Design-Builder shall include all elements of the design, and shall validate, refine, and detail the documentation to demonstrate that the design meets the requirements of this Section, corrects the barrier status of the crossing structure, and fulfills the Project's permit commitments. Each crossing shall have a separate PHD and FHD.

2.30.5.2 Flood Risk Analysis

Flood Risk Analysis was performed as part of Phase 1 Services.

If the design changes during the final design, the Design-Builder shall perform flood risk analysis for any earthwork activity associated with the Work that is within a Federal Emergency Management Agency (FEMA)-mapped 100-year floodplain, and document in the Flood Risk Analysis Technical Memorandum Specialty Report showing changes in floodplain elevations and locations where the Project creates a changed condition in the hydraulics of features that convey the 100-year floodwaters.

If the results of the flood risk analysis show a change to the existing FEMA map or base flood elevations, then a Conditional Letter of Map Revision (CLOMR) shall be required. The Design-Builder shall be responsible for all work to modify CLOMR resulting from final design changes and the Letter of Map Revision (LOMR) process during Phase 2 Work.

If any crossing is within a FEMA regulatory floodway, then a No-Rise Analysis and Certification is required per FEMA's *Procedures for "No-Rise" Certification for Proposed Development in the Regulatory Floodway* (Appendix 4).

The Design-Builder shall work with the Flood Plain Administrator (FPA) or Chief Executive Officer (CEO) of the community, or both, to determine whether a FEMA flood map revision is necessary based on the Design-Builder's final design. If a flood map revision is determined to be necessary, the Design-Builder shall complete hydraulic modeling and design to satisfy the requirements and documentation required by the FPA/CEO.

2.30.5.3 Fish Passable Structures

Fish passable structures shall comply with TR Section 2.13, *Bridges and Structures,* and this Section.

Galvanizing and zinc coatings shall not be used below the water surface elevation based on the 100-year Mean Recurrence Interval (MRI).

Where aluminum pipe or pipe arch is in contact with cement concrete or controlled density fill, two coats of paint shall be applied in accordance with the Mandatory Standards.

Construction of fish passable structures shall be included in the Environmental Compliance Plan.

2.30.5.3.1 Dimensions

The dimensions addressed in Table 2.30-B shall be established by the Design-Builder for each fish passage included in the PDB Contract during the Phase 1 Design Services, as a result of discussions with the Tribe(s), WDFW, and WSDOT Hydraulics staff. Table 2.30-B shall be completed by the Design-Builder and submitted to WSDOT as part of the Culvert Bundle Submittal.

1 **Table 2.30-B - Dimensions**

Notes	Characteristic (see Note 1)	***$$1$$***					
		Structure Characteristics					
	Fish Passage and Diversion Screening Inventory site ID #	***$$2$$***					
	Bankfull Width (minimum)	***$$3$$***					
	Hydraulic Clear Span (minimum)	***$$4$$***					
	Structural Clear Span (minimum)	***$$5$$***					
	Hydraulic Length (maximum)	***$$6$$***					
5	100 Year Design Freeboard (minimum)	***$$7$$***					
2	Maintenance Clearance (minimum)	***$$8$$***					
6	Structure type required	***$$9$$***					
	If a buried structure is used, is it required to be bottomless, such as a three-sided structure?	***$$10$$***					
	What Design Methodology is required?	***$$11$$***					
6	Are wing walls with a skew angle less than 60 degrees to the Bearing of Stream allowed?	***$$12$$***					

Notes	Characteristic (see Note 1)	***$$1$$***					
		Channel Characteristics					
	Channel section geometry	***$$13$$***					
3	Channel morphology	***$$14$$***					
2	Is the design required to allow, or prohibit, the channel to naturally Regrade?	***$$15$$***					
3	Proposed bed material	***$$16$$***					
4,6	Minimum number of Type Key LWM Pieces	***$$17$$***					
	LWM allowed within the Hydraulic Length of structure	***$$18$$***					

Notes:

1. See this Section for definitions of terms used in this table.
2. If the design is required to allow for Natural Channel Regrading, the structure and channel shall be designed to meet all PDB Contract requirements for both of the following cases: (1) the stream profile before Natural Regrading occurs (i.e., at initial completion of construction of this Contract), and (2) the stream profile after Natural Regrade occurs. "All PDB Contract requirements" includes, but is not limited to, the Structural Characteristics in Table 2.30-B.
3. Morphology and streambed gradation shall support the final design proposed by Design-Builder.
4. The number of LWM indicated is based on the proposed channel length in the PHD. Increases in impacted channel length will require installation of additional LWM.
5. Refer to TR Section 2.13, *Bridges and Structures* for allowable bridge and buried structure types.
6. See the Structure Free Zone Definitions Exhibit and the definition of Hydraulic Length.

Where a culvert or buried structure(s) is allowed and is proposed by the Design-Builder, the minimum thickness of streambed aggregate, between the interior structure bottom and the lowest point of the channel cross section, shall equal a minimum of the Total Scour from the Scour Check Flood plus 2 feet.

The stream channel profile and section shall transition to match the upstream and downstream channel profile and section within the impact limits.

2.30.5.4 Streambed Aggregates

Streambed cobbles, sediment, and boulder sizing for the design of fish passable structures shall be in accordance with the WSDOT *Hydraulics Manual* and the Standard Specifications.

The combined streambed material shall have a D_{50} that is within 20 percent of the reference reach D_{50} or shall correspond to WSDOT's standard specification 9-03.11(1) when the reference reach D_{50} is smaller than the specification's D_{50}, unless otherwise approved through the WSDOT Engineer and by the WSDOT State Hydraulics Engineer.

Streambed Sediment

The table located in Standard Specifications, Section 9-03.11(1), is replaced with the following:

Streambed Sediment	
Sieve Size	Percent Passing
2 ½"	99-100
2"	85-100
1"	50-82
½"	28-68
No. 40	10-20
No. 200	5-10

All percentages are by weight. Streambed Sediment shall meet the requirements of 9-03.11 of the Standard Specifications. Alternate gradations may be approved provided the following conditions are satisfied. The Design-Builder shall submit a Type 2 Working Drawing consisting of 0.45 power maximum density curve of the proposed gradation. The alternate gradation shall closely follow the maximum density line and have Nominal Aggregate Size of no less than 1½ inches or no greater than 3 inches. Approval of alternate gradations will require a successful streambed test section as determined by the SDE or designee and WSDOT HQ Hydraulics and an approved gradation meeting the requirements herein. The streambed test section shall demonstrate mixing methods of streambed aggregate into a uniform mix without voids that may cause subsurface flow.

Once approved, the streambed aggregate may be visually accepted.

2.30.5.4.2 Fine Band Material

The following new Section is added to Section 9-03.11 of the Standard Specifications:

9-03.11(5) Fine Band Material

If the Project requires the use of coarse bands, fine bands shall also be included in accordance with the WSDOT *Hydraulics Manual*. "Fine band material" shall be naturally occurring and shall conform to the following gradation.

Fine Band Material

Sieve Size	Percent Passing
No. 4	99-100
No. 10	46-86
No. 40	26-40
No. 200	10-20

All percentages are by weight.

2.30.5.4.3 Streambed Sand

The following new Section is added to Section 9-03.11 of the Standard Specifications.

9-03.11(6) Streambed Sand

"Streambed sand" shall conform to the following gradation.

Streambed Sand	
Sieve Size	Percent Passing
½"	99-100
3/8"	90-100
No. 4	90 Max
No. 8	32-67
No. 200	2-7

All percentages are by weight.

2.30.5.5 Large Woody Material

Materials for LWM and LWM anchoring shall follow the guidance in Chapter 10 of the WSDOT *Hydraulics Manual*. The Design Builder shall use native conifers for LWM with branches and limbs intact Metal components of the LWM anchors shall not be galvanized. Invasive plant species shall be removed from LWM prior to installation into the channel.

2.30.5.6 Stream Restoration

The Design-Builder shall design stream restoration through any new reaches or reaches disturbed by construction, and shall include, at a minimum, the following details:

- Streambed gravel and scour protection at the fish passable structures.
- Streambed gravel, LWM, and scour protection through the new stream channel sections.
- Horizontal alignment following natural stream radii and meanders following the Mandatory Standards.
- Vertical profile, incorporating complexities including but not limited to riffles, pools, and pool-riffles in accordance with the Mandatory Standards.
- Anchors for buoyant features such as LWM and large plantings to address forces that occur in the 100-year recurrent storm event.
- LWM and other habitat features used for stream restoration shall be included in the hydraulic model and the Final Hydraulic Design Report submittal.

The Design-Builder shall use SRH 2D hydraulic modeling software for pre-Project and post-Project condition, including all habitat and stream restoration components.

The Design-Builder shall coordinate the design and construction of this Work considering fish windows, temporary erosion control, and plant establishment to minimize potential impacts to flood risk in adjacent properties upstream and downstream of any new reaches or reaches disturbed by construction. Refer to TR Sections 2.8, *Environmental* and 2.15, *Roadside Restoration* for additional requirements.

The Design-Builder shall provide As Built survey data, including the stream construction and gradation of the streambed gravel and other materials with the SDE's certification that the As Built condition meets the design plans. The Design-Builder shall include this documentation as part of the As Built Hydraulic Design Report(s) for Fish Barrier Removal.

2.30.5.6.1 Habitat Features

At a minimum, the Design-Builder shall install a number of key LWM pieces that is consistent with the WSDOT *Hydraulics Manual* and the requirements in this Section. The Design-Builder shall host and lead meetings to coordinate the final design layout of LWM with the WSDOT Engineer, WSDOT Headquarters Hydraulics, WSDOT Headquarters & Fish Passage Biologist, WDFW, and tribal representatives.

The Design-Builder shall incorporate channel complexity elements inside the new structure(s). The channel complexity shall be accomplished through the use of habitat features that encourage the formation of pools and help maintain the channel shape. Final LWM and habitat features under and adjacent to structures shall be approved by the WSDOT State Hydraulics Engineer.

2.30.5.6.2 Channel Design

The Design-Builder shall design the channel top of bank, stream stabilization features, and woody vegetation in accordance with the Mandatory Standards, and these Technical Requirements. The channel bank shall be stabilized using bioengineering techniques such as, live stakes, and LWM to ensure that the channel will not erode into private property, WSDOT structures, or Utilities that are in the vicinity. Channel design shall avoid as much as possible new armoring with rock. New armoring with rock may require mitigation and the Design-Builder shall be responsible for mitigation as a result of armoring the channel with rock.

2.30.5.6.3 Site Work

The Design-Builder shall grade the area between the new fish passable structures, stream channels, and adjacent floodplain areas to prevent fish stranding. This Work shall include a continuous low-flow channel thalweg.

2.30.5.6.4 Floodplain Storage

The Design-Builder shall evaluate the floodplain volume resulting in grading (earthwork only) below elevations shown in the FEMA Flood Insurance Studies or Flood Insurance Rate Maps (FIRM). The Design-Builder shall verify the correct elevation ranges for floodplain volume calculations to assess change in floodplain storage for the correct elevation ranges shown in

FIRMs or floodplain studies. The As Built conditions shall meet or exceed pre-Project floodplain volume for each of these elevation ranges.

2.30.5.7 Scour Analysis and Long-Term Degradation/Aggradation

The Design-Builder shall perform a scour analysis that includes all habitat and stream restoration components in accordance with the Mandatory Standards and this Section. The scour analysis shall include all elements of Total Scour as defined by HEC-18. Scour depth shall be based on total scour without any countermeasures in place including final LWM layout. The scour analyses supporting all structures are considered part of the Specialty Report(s) and shall undergo a Peer Review.

At a minimum, the Peer Reviewer shall review the following aspects of the scour design and analysis:

- Geotechnical data collected and reasonableness of the assumptions made by the Design-Builder to develop the scour models used in the analyses.
- Field data collection.
- Assessments used to determine stream classification, stability, response, and level of analysis.
- Hydrologic analysis.
- Hydraulic analysis.
- Scour analysis input and results.
- Channel migration.
- Equations used in the calculation, if applicable.
- Verify compliance with the Mandatory Standards and this Section.
- Construction document details and specifications that result from the scour analysis.

2.30.6 *Construction Requirements*

2.30.6.1 Preconstruction Conference

A streambed preconstruction conference shall be held at least 5 Business Days prior to the Design-Builder beginning streambed construction to discuss the goals and methods of streambed construction which shall include the construction procedures, personnel, and equipment to be used.

Those attending shall include:

1. Design-Builder: The superintendent, on-site supervisor, Quality Assurance (QA), foreman, the Environmental Compliance Lead, SDE, and any other personnel that will have on-site responsibility for streambed material and habitat feature placement.
2. WSDOT: The WSDOT Engineer, Headquarters Hydraulics, and key inspection personnel.
3. Representatives from interested permitting agencies and Tribes shall be invited by WSDOT.

Notice of the meeting date shall be given to the WSDOT Engineer 14 Calendar Days prior to this meeting taking place.

2.30.6.2 Construction Oversight

The Design-Builder shall coordinate with the SDE and the WSDOT Engineer for oversight during all stream restoration and streambed construction work. This includes but is not limited to mixing and placement of streambed materials and installation of habitat features (key LWM pieces and complexity features within the structure).

Notice of the Work shall be given to the WSDOT Engineer 14 Calendar Days prior to each element of Work beginning.

2.30.6.3 Protection and Restoration of Sensitive Resource Areas

All Design-Builder, Subcontractor, and supplier employees that will perform Work on the Project Site shall have environmental training in accordance with TR Section 2.8, *Environmental*, and shall be aware that no access or impacts are permitted beyond the high visibility construction fencing.

2.30.6.4 Placing Aggregate in Streambed

Streambed Material shall be placed in the prepared channel excavation to the lines and grades shown on the plans and in such a way as to prevent material segregation. Streambed material shall be placed in lifts no thicker than 12 inches. Streambed material in its final location shall be a well graded mix.

Placement of streambed material shall be constructed to ensure that stream low flow rate of 30 gallons per minute or estimated 95 percent exceedance interval if available, whichever is lower, or as determined by the SDE, is conveyed above each streambed material lift. The Design-Builder shall apply water and sufficient streambed sand to each lift to facilitate filling the interstitial voids of the streambed materials. The voids are satisfactorily filled when water equivalent to the low flow rate of the stream does not go subsurface and there is no perceivable difference in the low flow rate from upstream of the Project limits to downstream of the Project limits. The Design-Builder shall apply water at the low flow rate to the stream channel for visual acceptance by the SDE. Water shall be free from contaminates, chlorination, and any additive that has a risk to fish and other ecological life.

The entire process of placing all streambed material, all streambed sand, and watering in each layer shall be a Hold Point, with attendance by QA, SDE and the WSDOT Engineer.

The Design-Builder shall minimize the potential for increased turbidity in accordance with State water quality standards and PDB Contract requirements. Any accumulated sediments shall be removed. The stream bypass shall remain in place until flows that are introduced to the new channel section at a rate equal to the existing stream flows comply with State water quality standards at the downstream end of the new channel. If no water is flowing in the creek at the time of the bypass removal, the Design-Builder shall apply water to the stream channel for visual acceptance by the SDE.

2.30.6.4.1 Streambed Test Section

This Section is intentionally omitted.

2.30.6.5 Rewatering the Stream Channel

Re-watering the stream channel shall be a Hold Point for each crossing. Prior to re-watering the stream channel, the SDE and WSDOT Engineer will meet with QA to conduct final inspection of As Built condition for channel shape, profile, and structure.

2.30.6.6 Abandonment of Existing Culvert Structures

Abandonment or removal of existing culverts shall be in accordance with Divisions 2 and 7 of the Standard Specifications. Any existing pipe or other structure that will be abandoned and will remain under any pavement shall be filled using methods and materials that ensure the pipe or structure is completely filled in a supported, non-void condition, prevent the pipe or structure from being a structural element and preventing future erosion of the fill material. The Design-Builder shall include the abandonment details, including any abandon-in-place filling methods and materials, in the Released for Construction (RFC) documents.

2.30.6.7 Streamflow Mean Recurrence Interval Monitoring and Reporting

For each fish passage in the contract, the Design-Builder shall develop and implement a discreet Streamflow MRI Monitoring Plan for use during the fish passage Warranty period(s). The plan shall:

1. Meet the standard of care in the field of professional hydrologic and hydraulic engineering.
2. Estimate the 25-year Mean Recurrence Interval (MRI) streamflow in Cubic Feet per Second (CFS). Provide a detailed explanation of the means and methods used to estimate the 25-year MRI streamflow. Identify sources of data and calculations.
3. Provide a stream gage capable of recording flows at a minimum of the 25-year MRI streamflow. The stream gage shall provide hourly readings for the duration of the fish passage Warranty. The plan shall provide a detailed explanation of the means and methods that will be used to measure and document-streamflow. The plan shall identify flow measuring equipment to be used and how data will be gathered and stored and shall provide a detailed explanation of how the field data will be converted and used to determine the actual streamflow in CFS.

The Design-Builder shall submit the Streamflow MRI Monitoring Plan as a Type 2 Working Drawing to the WSDOT Engineer for Review and Comment at least 60 Calendar Days prior to the first Fish Passage Operationally Complete Date. The Design-Builder shall:

1. Implement the approved plan prior to each Fish Passage Operationally Complete Date, respectively.
2. Implement the approved plan throughout the duration of each fish passage Warranty period.

2.30.7 *Submittals*

All submittals shall be electronic. All pages of all submittals shall be in searchable PDF format. In addition to the searchable PDF format, submittals that include hidden information not visible in PDF format (such as calculations in the cells of a spreadsheet or drawing) shall be submitted in their original format (such as Word, Excel, InRoads) to facilitate WSDOT's full review and understanding of the basis and assumptions for calculations and other output. Proprietary calculation Excel worksheets shall be provided in pdf form for a representative site with equations listed.

Modeling, maps, and spreadsheets may be on 11-inch by 17-inch pages when printed. Otherwise, electronic submittals, when printed, shall fit legibly on an 8-1/2 inch by 11inch page.

2.30.7.1 Design Plans

The Design-Builder shall prepare stream plan sheets for the Project in accordance with TR Section 2.28 *Quality Management Plan and* the WSDOT Plans Preparation Manual. The stream plan sheets at a minimum shall have a plan, profile, cross section(s) through crossing structure, upstream cross section(s) and downstream cross section(s) that provide enough information to layout and construct the details of the Work including elevation information.

2.30.7.2 Design Calculations

The Design-Builder shall complete all calculations necessary for the design of the Work and include these calculations in the applicable Specialty Report(s). The Design-Builder shall prepare calculations in accordance with the Mandatory Standards to support the design shown in the plans and details.

The Specialty Report(s) shall describe the approach taken and the order of the calculations, including sections on the methodologies used (appropriateness and accuracy requirements), design decisions made, and resultant summaries. The calculations shall include electronic copies of the input and output from the supporting computer programs, spreadsheets, hand calculations, exhibits, and sketches. At a minimum, the calculations shall also include the following items:

- Design Calculations – These calculations shall include design criteria, hydrology and hydraulics calculations, and pertinent computer input and output data (reduced to 8.5-inch by 11-inch sheet size). The calculations shall include a narrative of the approach taken, and final conclusions and summaries of the calculation results in both narrative and table format. The calculations shall be in logical order, technically clear, and cross-referenced to correspond directly with drainage structure and basin numbering on the hydraulics feature.
- Special Design Features – The Design-Builder shall include a brief narrative of design decisions or revisions, electronic files from design calculations, and the reasons for them.
- Design decision summaries.
- Technical Specifications necessary for construction.

- Drainage maps showing the fish passage structures and any other illustrations necessary to support and clarify the design calculations. Electronic design drawings and maps, when printed, shall be on 11-inch by 17-inch pages.
- Hydraulic analysis (SRH-2D).
- Channel section design.
- Streambed material sizing.
- Scour analysis.
- Scour analysis for streambed gravel sizing around LWM structures, if applicable.
- LWM buoyancy and anchoring calculations, if applicable.

2.30.7.3 Specialty Reports

The Design-Builder shall submit all Specialty Reports required by the WSDOT *Hydraulics Manual* to document that hydraulics have been appropriately analyzed in the design of structures for the Project. For stream channel and stream crossing designs, the Specialty Report shall follow the template provided for Hydraulic Design Report in Appendix 4. Each stream shall have a separate Specialty Report. The Design-Builder shall allow 14 Calendar Days for the WSDOT Engineer's review and comment for each Specialty Report listed in this Section. All Specialty Reports shall undergo a Peer Review prior to each submittal of the Special Report to the WSDOT Engineer.

For all fish passage structures, the Design-Builder shall submit a Draft Final Hydraulic Design Report as part of the Phase 1 Services for Fish Barrier Removal with the conceptual Stream Design Plans to support the WSDOT Engineer's Review and Comment of the stream design drawings for the Project. The Draft Final Hydraulic Design Report for Fish Barrier Removal shall follow the template provided in Appendix 4 and shall include habitat features and total scour. The Draft Final Hydraulic Design Report and model results shall be submitted and reviewed by WSDOT prior to the submittal of JARPA.

If the Design-Builder proposes a design that changes any component or element as described in the Draft Final Hydraulic Design Report prepared during the Phase 1 Services, then a revised Draft Final Hydraulic Design Report shall be submitted for review that includes draft plans and draft model results.

The Final Hydraulic Design Report(s) shall bear the Professional Engineering stamp and signature of the SDE.

2.30.7.3.1 Draft Final Hydraulic Design Report(s)

The Design-Builder shall submit draft Final Hydraulic Design Report(s) for fish barrier removal as part of Phase 1 Services to the WSDOT Engineer for Review and Comment. The draft Final Hydraulic Design Report(s) for fish barrier removal shall include the stream design drawings for the Project, specific plans/details for proposed habitat features, documentation for total scour and any additional supporting hydraulic model results. Comment resolution of the WSDOT Engineer's review of the draft Final Hydraulic Design Report(s) shall be complete prior to the submittal of the JARPA.

2.30.7.3.2 Final Hydraulic Design Report(s)

The Design-Builder shall assemble the Final Hydraulic Design Report(s) for fish barrier removal to reflect the final Released for Construction hydraulic design.

2.30.7.3.3 As Built Hydraulic Design Report(s)

The Design-Builder shall submit an As Built Hydraulic Design Report(s) to document any changes to the design that deviate from the Final Hydraulic Design Report(s).

2.30.7.4 Shop Drawing Submittals

Refer to TR Section 2.28, Quality Management Plan, for all shop drawing submittals for fish passable structures.

2.30.7.5 Design Revisions During Construction

Calculations for revisions made during construction shall be incorporated into the As Built Hydraulic Design Report when construction is complete.

When new plan sheets or revised sheets are required as part of a construction revision, the revisions shall be made in accordance with TR Section 2.28, *Quality Management Plan* and are subject to WSDOT Review and Comment.

2.30.7.6 List of Submittals

At a minimum, Phase 2 Work submittals shall include the following:

- Drainage design calculations submitted with the corresponding Stream Design Plans
- Final Hydraulic Design Report(s), and
- As Built Hydraulic Design Report(s)
- Specialty Report Peer Reviewer credentials
- Draft submittal of electronic finals for the as built Hydraulic Design Report(s)
- Final submittal of electronic files for the as built Hydraulic Design Report(s).
- Final temporary stream diversion plan
- Design-Builder fish passable structure inspection reports and documentation of any repairs during the Warranty period

2.30.8 *Fish Passage Warranty*

Each individual fish passage in the Culvert Bundle Amendment shall have a discrete fish passage Warranty. During the fish passage Warranty periods, the Design-Builder's representative shall accompany the WSDOT Engineer annually at a mutually agreeable time and location for site inspections of the crossings. The WSDOT Engineer will inform the Design-Builder approximately two weeks after the joint site inspection of any violations of the fish passage Warranty requirements which require corrective action. In addition to the foregoing, at any time during a fish passage Warranty period, if the WSDOT Engineer determines that any of the fish passage Work has not met the standards set forth in the PDB Contract fish passage Warranty requirements, the Design-Builder shall correct the Work

within 10 months of being notified for the need for the corrections, even if the performance of such correction extends beyond the stated fish passage Warranty period. Failure by the Design-Builder to make timely corrections may result in the fish passage Warranty period be extended, in the sole judgment of the WSDOT Engineer. Necessary In Water Work Windows and permitting review timelines may extend the 10-month correction window if requested by the Design-Builder.

The Design-Builder shall be responsible for obtaining any necessary permits, providing traffic control, modifying the channel and/or crossing, and performing all other Work necessary to provide unimpeded fish passage that complies with the PDB fish passage Warranty requirements, at no cost to WSDOT except as explicitly provided in this Section.

2.30.8.1 Fish Passage Warranty Requirements

WSDOT will monitor the fish passage sites for changes in stream channel and associated habitat features during the Warranty periods. The criteria in Performance List A and the criteria in Performance List B will be used to determine acceptable performance of each fish passage site during each Fish Passage Warranty Period. If any criteria are not met, warranty work including construction, design, and any other incidental Work shall be performed by the Design-Builder as needed to bring the Work into compliance.

Fish Passage Warranty Performance List A:

1. Bed material throughout structure is present and consistent with the common condition or design.
2. Continuous and distinct thalweg is maintained throughout the constructed reach.
3. Low flow channel is not entrained along the structure walls for greater than 25% of the length of the structure.
4. Structure freeboard meets requirements documented in design.
5. Channel shape, Bankfull Width (BFW), and flow depths through structure and design channel are consistent with the common condition or design.
6. Channel plan form is consistent with the common condition or design.
7. Channel slope is consistent with the common condition or design.
8. The extent and severity of subsurface flow within the project limits shall not exceed the extent and severity of subsurface flow in the common condition at time of inspection.
9. There shall be no channel-spanning hydraulic drops greater than 0.8’ within the project limits unless the design provided for greater hydraulic drops, in which case the hydraulic drops shall be consistent with design expectations and not exceed the drop limits documented in the FHD and HPA.

Fish Passage Warranty Performance List B:

a) The channel bed scour shall not exceed the anticipated scour from the Scour Design Flood event in the Final Hydraulic Design Report.

2.30.8.2 Fish Passage Warranty Work Cost Responsibility

For the duration of each fish passage Warranty, the Design-Builder shall be responsible for (1) gathering, recording, and evaluating MRI Streamflow data, and (2) reporting the Streamflow monitoring results to WSDOT, and other work as required by the MRI Streamflow Monitoring Plan at no additional cost to WSDOT.

Performance List A: If the WSDOT Engineer concurs that flow has exceeded the 25-year streamflow MRI and deems remedial work for the items in Performance List A is required as a result of that flow, the Design-Builder shall be entitled to Uncontrollable Circumstances relief or Base Culvert Bundle Guaranteed Maximum Price Adjustment in accordance with Article 14 of this PDB Contract for the remedial work made necessary because of the flow event exceeding the 25-year streamflow MRI. The Design-Builder shall not be entitled to Uncontrollable Circumstances or Base Culvert Bundle Guaranteed Maximum Price Adjustments for remedial work needed to correct deficiencies of items in Performance List A when the need for such remedial work is caused by stream flow events less than or equal to the 25-year streamflow MRI.

Performance List B: If the WSDOT Engineer concurs that flow has exceeded a 25-year streamflow MRI and deems remedial work for the items in Performance List B is required as a result of that flow, the Design-Builder shall be entitled to Uncontrollable Circumstances relief or Base Culvert Bundle Guaranteed Maximum Price Adjustment in accordance with Article 14 of this PDB Contract for the remedial work made necessary because of the flow event exceeding the Scour Design Flood. The Design-Builder shall not be entitled to Uncontrollable Circumstances or Base Culvert Bundle Guaranteed Maximum Price Adjustments for remedial work needed to correct deficiencies of items in Performance List B when the need for such remedial work is caused by stream flows less than or equal to a 25-year streamflow MRI.

It shall be understood that remedial work includes but is not limited to design, redesign, obtaining any necessary permits, providing traffic control, and all other Work necessary to comply with the Fish Passage Warranty requirements.

2.30.9 *Fish Passage Indemnity*

For indemnities regarding fish passage sites, see Section 15.3 (WSDOT's Obligation to Indemnify) of the PDB Contract.

End of Section